

What is claimed is:

1. An electrosurgical apparatus comprising:
 - (a) an electrosurgical return electrode having a bulk impedance sufficient to limit the density of an electrosurgical current to safe levels; and
 - (b) an inductor coupled in series with the electrosurgical return electrode, wherein the inductor counteracts at least a portion of an effective impedance of the electrosurgical return electrode and a patient.
2. The electrosurgical apparatus of claim 1, wherein the inductor is selected from the group consisting of a solid state inductor, an electro-mechanical inductor, a fixed inductor, a variable inductor, solid state wave shaping circuitry or any combination thereof.
3. The electrosurgical apparatus of claim 1 wherein the inductor is selected such that the effective impedance of the electrosurgical return electrode, the patient, and the inductor falls within a range of impedances at which effective electrosurgery can be performed for a selected group of patients.
4. The electrosurgical apparatus of claim 3 wherein the upper limit of the range of impedances has substantially the same magnitude as the lower limit of the range of impedances.
5. The electrosurgical apparatus of claim 1, wherein the effective impedance of the electrosurgical return electrode comprises a capacitive component.
6. The electrosurgical apparatus of claim 5, wherein the effective impedance of the electrosurgical return electrode further comprises a resistive component.

7. The electrosurgical apparatus of claim 5, wherein the effective impedance of the electrosurgical return electrode further comprises an inductive component.
8. The electrosurgical apparatus of claim 1, wherein the inductor optimizes the flow of the electrosurgical current by counteracting a capacitive component of the effective impedance of the electrosurgical return electrode.
9. The electrosurgical apparatus of claim 1, wherein the inductor controls the flow of electrical current by counteracting at least a portion of the effective impedance associated with the return electrode and the patient.
10. The electrosurgical apparatus of claim 9, wherein the return electrode is of a size that would normally be used on an adult sized patient and wherein the inductor counteracts the effective impedance associated with the return electrode and the patient such that electrosurgery on patients weighing less than 25 pounds can be performed effectively and safely.
11. The electrosurgical apparatus of claim 9, wherein the inductor counteracts at least a portion of the effective impedance associated with the return electrode and the patient such that the electrosurgical return electrode can be utilized for neonatal applications.
12. The electrosurgical apparatus of claim 1, wherein an inductive reactance provided by the inductor counteracts a portion of a capacitive reactance wherein the portion of the capacitive reactance is not needed to limit the density of the electrosurgical current to safe levels.

13. The electrosurgical apparatus of claim 12, wherein the portion of the capacitive reactance is not more than the capacitance of the effective impedance when the contact area between the patient and the return electrode is sufficient to limit the current density to safe levels without the bulk impedance.

14. An electrosurgical apparatus for use in electrosurgery wherein an electrosurgical current is utilized to cut and coagulate tissue, configured to limit the density of the electrosurgical current to safe levels so as to prevent unwanted patient burn, the electrosurgical apparatus comprising:

(a) an electrosurgical return electrode having a bulk impedance sufficient to limit the density of an electrosurgical current to safe levels, wherein the bulk impedance comprises a capacitive component; and

(b) an inductor coupled in series with the electrosurgical return electrode, the inductor being configured to increase the flow of the electrosurgical current by counteracting at least a portion of the capacitive component of the effective impedance of the electrosurgical return electrode and a patient.

15. The electrosurgical apparatus of claim 14, wherein the inductor comprises a plurality of inductors.

16. The electrosurgical apparatus of claim 15, wherein the plurality of inductors are adapted to provide variable amounts of inductance.

17. The electrosurgical apparatus of claim 14, wherein the inductor comprises a variable inductor.

18. The electrosurgical apparatus of claim 17, wherein the variable inductor is tunable.

19. The electrosurgical apparatus of claim 18, wherein the variable inductor is tunable such that that the overall effective impedance is optimized for electrosurgery when the contact area between the electrosurgical return electrode and the patient is greater than the minimum contact area needed to prevent unwanted burns.

20. The electrosurgical apparatus of claim 18, wherein the variable inductor is tunable such that the overall effective impedance is optimized for electrosurgery when the contact area is sufficient to limit the electrosurgical current density to safe levels.

21. The electrosurgical apparatus of claim 17, further comprising a logic module to tune the impedance level of the variable inductor.

22. The electrosurgical apparatus of claim 17, further comprising a sensor adapted to sense the properties of the electrosurgical current such that the capacitive component of the electrosurgical effective impedance can be determined.

23. An electrosurgical apparatus for use in electrosurgery wherein an electrosurgical current is utilized to cut and coagulate tissue, and to limit the density of the electrosurgical current to safe levels so as to prevent unwanted patient burn, the electrosurgical apparatus comprising:

(a) an electrosurgical return electrode having an bulk impedance sufficient to limit the density of an electrosurgical current to safe levels, wherein the electrosurgical return electrode has an effective impedance resulting from the properties of the bulk impedance and the contact area between the patient and the return electrode, the effective impedance having a capacitive component;

(b) a variable inductor coupled in series with the electrosurgical return electrode, the variable inductor being configured to increase the flow of the electrosurgical current by counteracting the capacitive component of the effective impedance of the electrosurgical return electrode when the amount of contact area between the patient and the electrosurgical return electrode is sufficient to conduct electrosurgery; and

(c) circuitry adapted to identify the amount of capacitive reactance in an electrosurgical pathway including the electrosurgical generator and the variable inductor and tune the variable inductor to optimize the flow of the electrosurgical current by minimizing the capacitive reactance in the electrosurgical pathway.

24. The electrosurgical apparatus of claim 23, wherein the circuitry identifies the amount of capacitive reactance while electrosurgery is being performed.

25. The electrosurgical apparatus of claim 24, wherein the circuitry is adapted to tune the variable inductor while electrosurgery is being performed.

26. The electrosurgical apparatus of claim 23, wherein separate monitoring circuitry is utilized to identify the amount of capacitive reactance in the electrosurgical circuit.

27. The electrosurgical apparatus of claim 23, wherein the inductor is positioned in an electrosurgical tool.

28. The electrosurgical apparatus of claim 23, wherein the inductor is positioned in an electrosurgical generator.

29. The electrosurgical apparatus of claim 23, wherein the inductor is positioned in cabling.

30. The electrosurgical apparatus of claim 23, wherein the inductor is tunable such that the capacitive reactance is counteracted when the contact area between the patient and the electrosurgical electrode is sufficient to limit the electrosurgical current to safe levels.

31. The electrosurgical apparatus of claim 23, wherein the inductor is configured to maintain the impedance in the electrosurgical pathway above a level below which would result in unsafe electrosurgical current densities when the contact area between the patient and the electrosurgical electrode is insufficient to limit the electrosurgical current densities to safe levels without the bulk impedance.

32. An electrosurgical apparatus for use in electrosurgery wherein an electrosurgical current is utilized to cut and coagulate tissue and to limit the density of the electrosurgical current to safe levels so as to prevent unwanted patient burn, the electrosurgical apparatus comprising:

(a) an electrosurgical return electrode adapted to contact a patient wherein the combination of the return electrode and the patient in contact with the return electrode comprises a capacitive reactance sufficient to limit the density of an electrosurgical current to safe levels, when the electrode is at least partially in contact with a patient;

(b) an inductor coupled in series with said electrode, the inductor being configured to increase the flow of the electrosurgical current by utilizing the phase angle and magnitude of the inductance to reduce the capacitive reactance of the electrode.

33. The electrosurgical apparatus of claim 32, wherein the properties of the inductor are selected based on the capacitive reactance of the electrode when a patient is in sufficient contact with the electrosurgical return electrode to limit the density of the electrosurgical current to safe levels.

34. The electrosurgical apparatus of claim 32, wherein said electrosurgical return electrode comprises electrically conducting material having an effective bulk impedance equal to or greater than about $4,000 \Omega \cdot \text{cm}$.

35. The electrosurgical apparatus of claim 32, wherein said electrosurgical return electrode comprises an electrically conducting material having an effective bulk impedance equal to or greater than about $10,000 \Omega \cdot \text{cm}$.

36. The electrosurgical apparatus of claim 32, wherein the capacitive reactance is sufficient to limit the electrosurgical current density to less than 100 millamperes per centimeter.

37. An electrosurgical return electrode adapted to prevent unwanted patient burns comprising:

a semi-insulating element having a bulk impedance sufficient to prevent a patient burn when a contact area between a patient and the semi-insulating element is below a given threshold;

an electrically conductive member coupled to the semi-insulating element, the conductive member cooperating with circuitry that identifies the area of contact between the patient and the semi-insulating element and if the area of contact is below a given threshold; and

an inductor coupled in series with the bulk impedance wherein the inductor is configured to counteract at least a portion of an effective impedance caused when the patient is in limited contact with the electrosurgical return electrode.

38. The return electrode of claim 37, wherein the electrically conductive member comprises a split plate.

39. The return electrode of claim 38, wherein the split plate is configured such that the area of contact between the patient and the semi-insulating element can be measured notwithstanding the total surface area of the semi-insulating element and the portion of semi-insulating element the patient is contacting.

40. The return electrode of claim 39, wherein the split plate comprises a split plate member having a first conductor and a second conductor interwoven in a lattice structure.

41. The return electrode of claim 40, wherein the circuitry measures the impedance between the first conductor and the second conductor.

42. The return electrode of claim 37, wherein the electrically conductive member includes a plurality of membrane switches.

43. The return electrode of claim 37, further comprising monitoring circuitry to identify a capacitive reactance portion of the effective impedance.

44. A return electrode having a surface adapted to be positioned directly on a patient, the return electrode comprising:

a first conductor;

a second conductor interwoven with the first conductor to create a lattice structure where the lattice structures promotes uniform flow of current over the surface of the return electrode, wherein the first and second conductors comprise a bulk impedance sufficient to prevent a patient burn when a contact area between a patient and the first and second conductors is below a given threshold; and

an inductor coupled in series with the bulk impedance wherein the inductor is configured to counteract at least a portion of an effective impedance caused when the patient is in contact with the first and second conductors.

45. The return electrode of claim 44, wherein the inductor is selected from the group consisting of a solid state inductor, an electro-mechanical inductor, a fixed inductor, a variable inductor, solid state wave shaping circuitry or any combination thereof.

46. The return electrode of claim 44 wherein the inductor is selected such that the effective impedance falls within a range of impedances at which effective electrosurgery can be performed for a selected group of patients.

47. The return electrode of claim 46 wherein the upper limit of the range of impedances has the same magnitude as the lower limit of the range of impedances.

48. The return electrode of claim 44, wherein the effective impedance comprises a capacitive component.

49. The return electrode of claim 48, wherein the effective impedance further comprises a resistive component.

50. The return electrode of claim 48, wherein the effective impedance further comprises an inductive component.

51. The return electrode of claim 44, wherein the inductor counteracts a capacitive component of the effective impedance of the electrosurgical return electrode.

52. An electrosurgical apparatus comprising:
- (a) an electrosurgical return electrode having a bulk impedance sufficient to limit the density of an electrosurgical current to safe levels; and
 - (b) a reactance coupled in series with the electrosurgical return electrode, the reactance being configured to increase the flow of the electrosurgical current by counteracting a portion of an effective impedance caused when a patient is in contact with the electrosurgical return electrode.
53. The electrosurgical apparatus of claim 52, wherein the effective impedance includes an inductive component.
54. The electrosurgical apparatus of claim 53, wherein the reactance is a capacitor coupled in series with the electrosurgical return electrode configured to counteract at least a portion of the inductive component.
55. The electrosurgical apparatus of claim 52 wherein the reactance is selected such that the combination of the effective impedance and the reactance falls within a range of impedances at which effective electrosurgery can be performed for a selected group of patients.
56. The electrosurgical apparatus of claim 55 wherein the upper limit of the range of impedances has the same magnitude as the lower limit of the range of impedances.
57. The electrosurgical apparatus of claim 53 further comprising monitoring circuitry to identify the inductive component of the effective impedance.

58. The electrosurgical apparatus of claim 54, wherein the capacitor is configured to not reduce the combination of the effective impedance and the reactance to a level that would allow unsafe electrosurgical current densities when the contact area between the patient and the electrosurgical return electrode is insufficient to limit the electrosurgical current densities to safe levels without the bulk impedance.